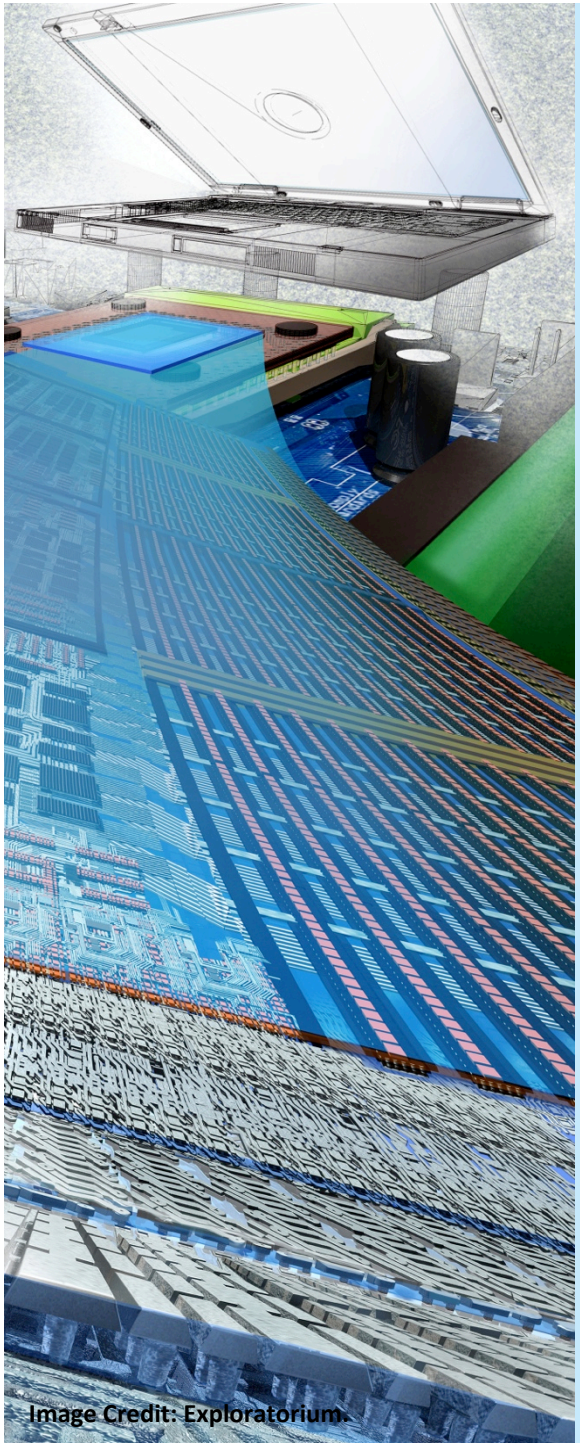


CISE Priorities and Budget Update

Farnam Jahanian
CISE Directorate
National Science Foundation

CISE Advisory Committee Meeting
May 16-17, 2013

CISE and National Priorities

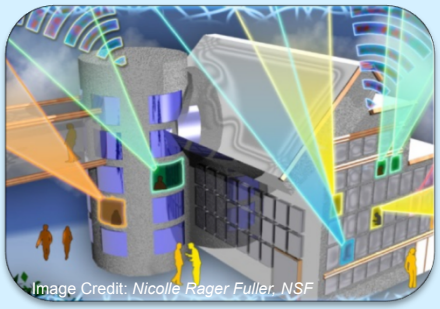


Image Credit: *Nicolle Rager Fuller, NSF*

Broadband & Universal Connectivity

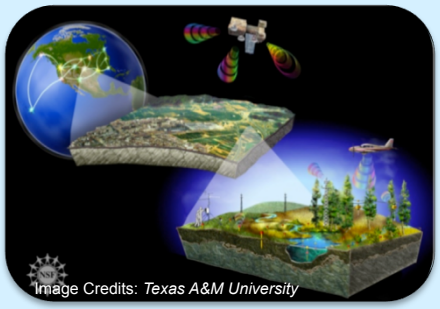


Image Credits: *Texas A&M University*

Environment & Sustainability


Image Credit: *Nicolle Rager Fuller, NSF*

Emergency Response & Disaster Resiliency

Health & Wellbeing


Image Credit: *MicroStrain, Inc.*

Manufacturing, Robotics, & Smart Systems


Image Credit: *ThinkStock*

Secure Cyberspace

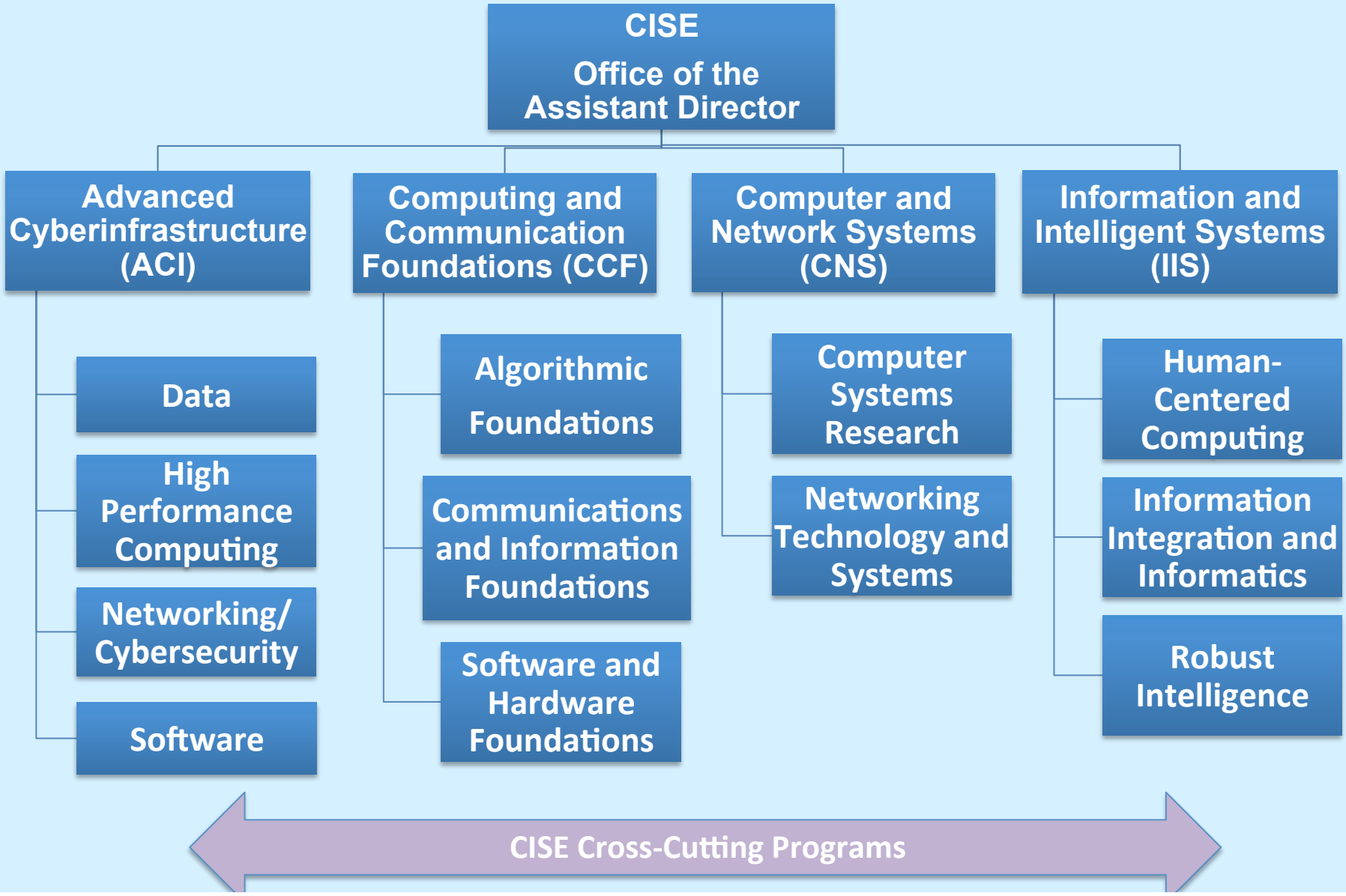

Image Credit: *Cisco, Inc.*

Transportation & Energy


Image Credit: *Georgia Computes! Georgia Tech*

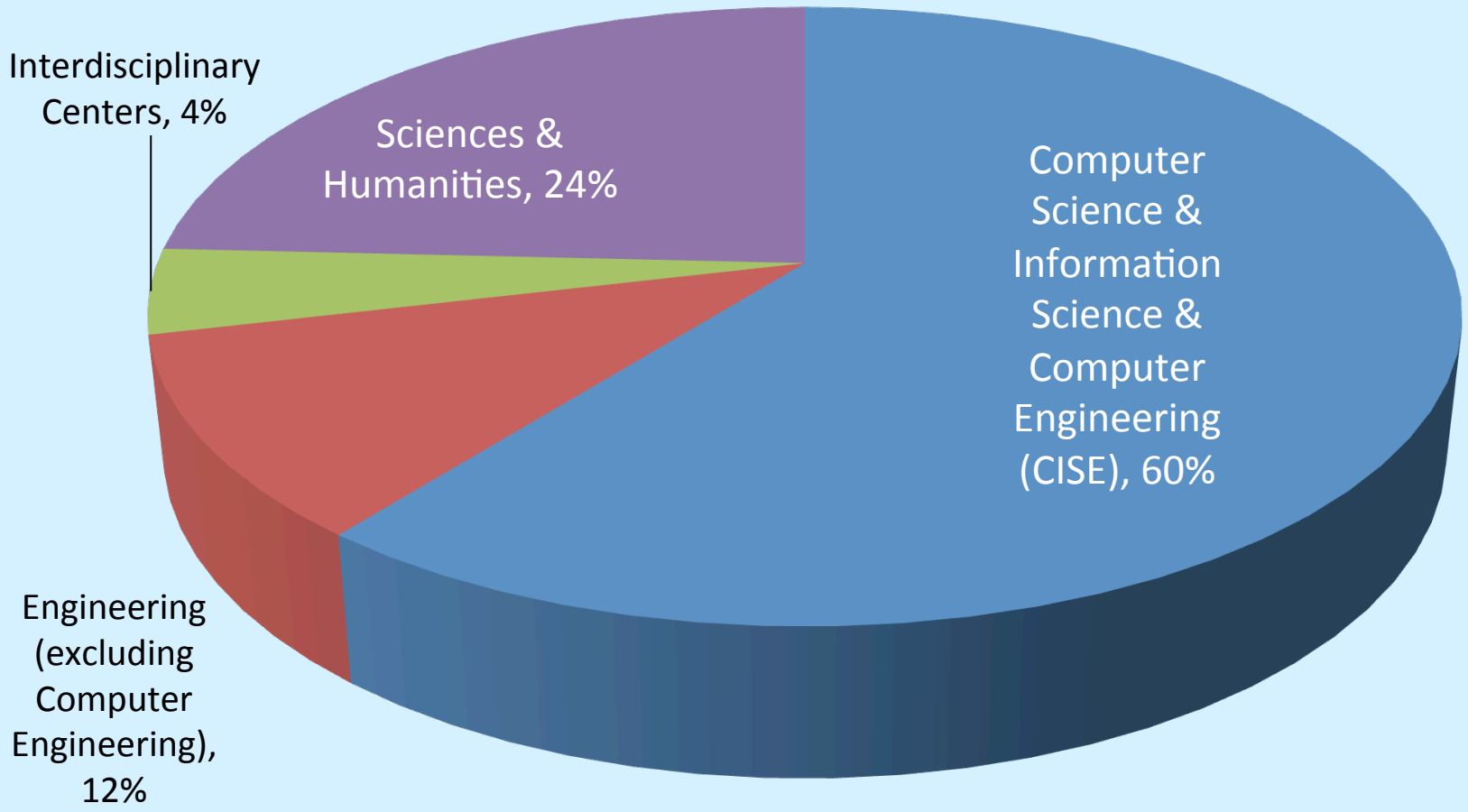
Education & Workforce Development

CISE Directorate



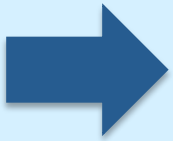
Who is the CISE community?

PI and Co-PI Departments for FY 2012 Awards by NSF CISE



Snapshot of CISE FY 2012 Activities

	CISE
Research Budget	$865M
Number of Proposals	7,695
Number of Awards	1,741
Success Rate	~22%
Average Annualized Award Size	$200K
Number of Panels Held	316
Number of People Supported	18,460



	CISE
Senior Researchers	8,417
Other Professionals	943
Postdoctoral Associates	371
Graduate Students	6,131
Undergraduate Students	2,513

FY 2014 Budget Request

- **NSF**
  - FY 2014 Budget Request -- $7,625.78M
  - Increase over FY 2012 Enacted -- $592.69M or 8.4%

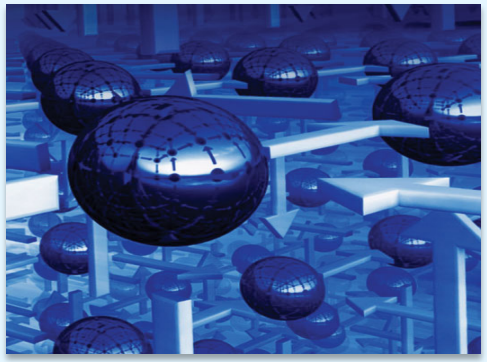
- **CISE**
  - FY 2014 Budget Request -- $950.25M Increase over FY 2012 Enacted -- $85.02M or 9.8%

- CISE FY 2014 request is shaped by investments in core research, education, and infrastructure programs as well as investments in NSF cross-foundation priorities and programs

Emerging Frontiers

Data Explosion

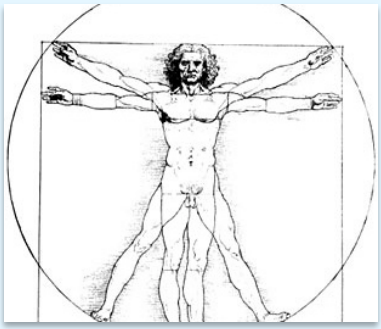
Smart Systems: Sensing, Analysis and Decision



Expanding the Limits of Computation

Secure Cyberspace

Universal Connectivity



Augmenting Human Capabilities

New Programs and Initiatives

- **Big Data Initiative (NSF 12-499)**
- **Exploiting Parallelism and Scalability, XPS (NSF 13-507)**
- **CyberSEES (NSF 13-500)**
- **Hazards SEES (NSF 12-610)**
- **Campus Cyberinfrastructure – Network Infrastructure and Engineering Program, CCNIE (NSF 13-530) – 2nd year**
- **Failure-Resistant Systems, jointly with SRC (NSF 12-566)**
- **US Ignite**
- **Data Infrastructure Building Blocks (NSF 12-557)**
- US-Finland Wireless Innovation
- United States-Israel Collaboration in Computer Science, USICCS (NSF 12-603)
- Future Internet Architectures – Next Phase, FIA-NP (NSF 13-538)
- Computing Education for the 21st Century, CE21 (NSF 12-609)
- National Robotics Initiative, NRI (NSF 12-607) – 2nd year
- Secure and Trustworthy Cyberspace, SaTC (NSF 12-596) – 2nd year
- CISE-MPS Interdisciplinary Faculty Program in Quantum Information Science (NSF 12-540)

Campus Cyberinfrastructure - Network Infrastru
Engineering Program (CC-NIE)

PROGRAM SOLICITATION
NSF 13-530

REPLACES DOCUMENT(S):
NSF 12-541

National Science Foundation
Office of Cyberinfrastructure
Directorate for Computer & Information Science & Engineering
Division of Computer and Network Systems

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
April 03, 2013

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), NSF 13-1, was issued on 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that the gu contained in NSF 13-1 apply to proposals submitted in response to this funding opportunity. Proposers who opt t prior to January 14, 2013, must also follow the guidelines contained in NSF 13-1.

Please be aware that significant changes have been made to the PAPPG to implement revised merit review criteria based National Science Board (NSB) report, National Science Foundation's Merit Review Criteria: Review and Revisions. While the merit review criteria remain unchanged (Intellectual Merit and Broader Impacts), guidance has been provided to clarify and the function of the criteria. Changes will affect the project summary and project description sections of proposals. Annual and reports also will be affected.

A by-chapter summary of this and other significant changes is provided at the beginning of both the Grant Proposal Guide and Award & Administration Guide.

Please note that this program solicitation may contain supplemental proposal preparation guidance and/or guidance that deviate from the guidelines established in the Grant Proposal Guide.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:
Campus Cyberinfrastructure - Network Infrastructure and Engineering Program (CC-NIE)

Synopsis of Program:
The "Campus Cyberinfrastructure - Network Infrastructure and Engineering (CC-NIE)" program invests in improvements and re-engineering at the campus level to support a range of data transfers supporting computational science and computer networks and systems research. The program also supports Network Integration activities tied to achieving higher levels of performance, reliability and predictability for science applications and distributed research projects. Two types of CC-NIE awards will be made. Data Driven Networking and Infrastructure for the Campus and Researcher awards will be supported at up to $500,000 total for up to 2 years. Network Integration and Applied Innovation awards will be supported at up to $1,000,000 total for up to 2 years.

Cognizant Program Officer(s):
Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Kevin Thompson, OCI Program Director, telephone: (703) 292-4220, email: kthompso@nsf.gov
- Joseph B. Lyles, CNS Program Director, telephone: (703) 292-7152, email: jlyles@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.070 --- Computer and Information Science and Engineering
- 47.080 --- Office of Cyberinfrastructure

Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS)

Accelerating advances in 21st century smart engineered systems

- Creating smart systems that sense, respond, and adapt to the environment.
- In partnership with BIO, ENG, and MPS, CISE aims to:
  - Establish a scientific basis for engineered systems interdependent with physical world and social systems;
  - Synthesize multi-disciplinary knowledge to model and simulate systems in full complexity and dynamics; and
  - Develop a smart systems technology framework.
- CISE focus includes Advanced Manufacturing, Cyber-Physical Systems (CPS), and the National Robotics Initiative (NRI) and their interaction.

Research to Enable Smart Systems

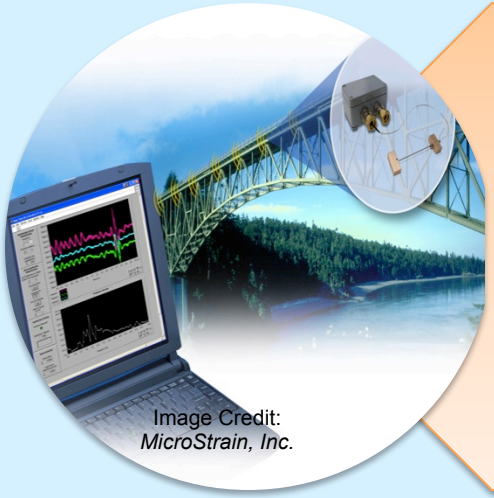


Image Credit: *MicroStrain, Inc.*

Cyber-Physical Systems (CPS)

- ***Deeply integrate computation, communication, and control into physical systems***
- Aspects of CPS include pervasive computation, sensing and control; networking at multi- and extreme scales; dynamically reorganizing/reconfiguring systems; and high degrees of automation
- Dependable operation with high assurance of reliability, safety, security, and usability

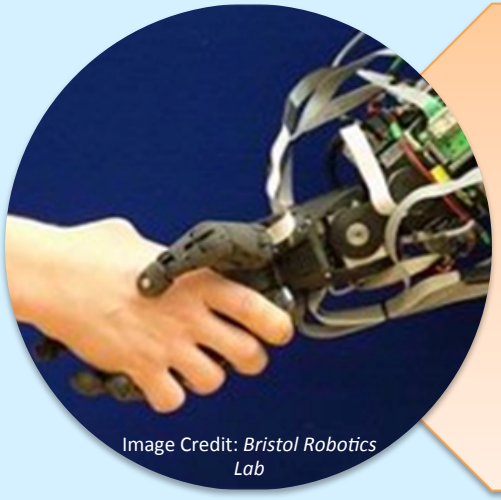
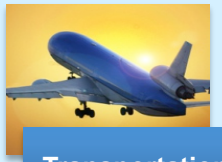


Image Credit: *Bristol Robotics Lab*

National Robotics Initiative (NRI)

- ***Develop the next generation of collaborative robots, or co-robots, that work beside and cooperatively with people***
- A nationally concerted cross-agency effort among NSF, NASA, USDA, and NIH
- Initiative includes aim to understand the long-term social, behavioral, and economic implications
- Potential to enhance personal safety, health, and productivity

Application sectors



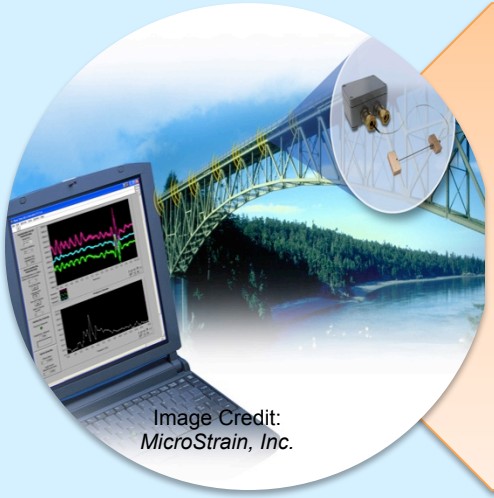
Transportation

Energy and Industrial Automation

Health and Medical Care

Critical Infrastructure

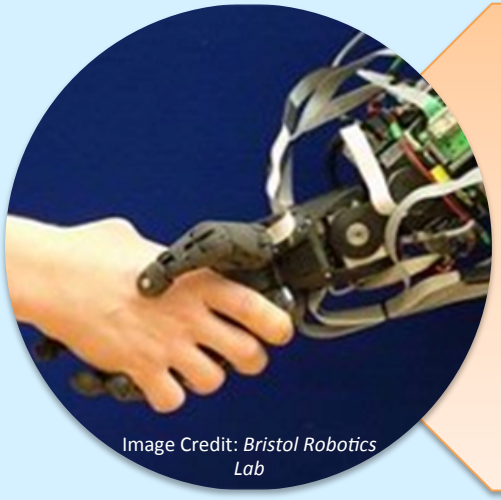
Research to Enable Smart Systems



200+ total awards since 2009:
- $140M+ total investment
- 350+ PIs and Co-PIs
- 35 states

FY 12 commitment:
- 45 new awards (29 projects)
- $30M+ investment

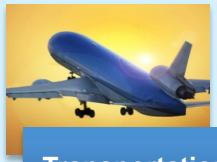
Coming this Year:
- Frontiers in CPS



Over 700 proposals submitted & $1B in funding requested

NSF FY 12 commitment:
- ~$30M (~$50M across agencies)
- 31 projects
- 108 PIs and Co-PIs
- 22 states

Application sectors


Transportation


Energy and Industrial Automation


Health and Medical Care


Critical Infrastructure

Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

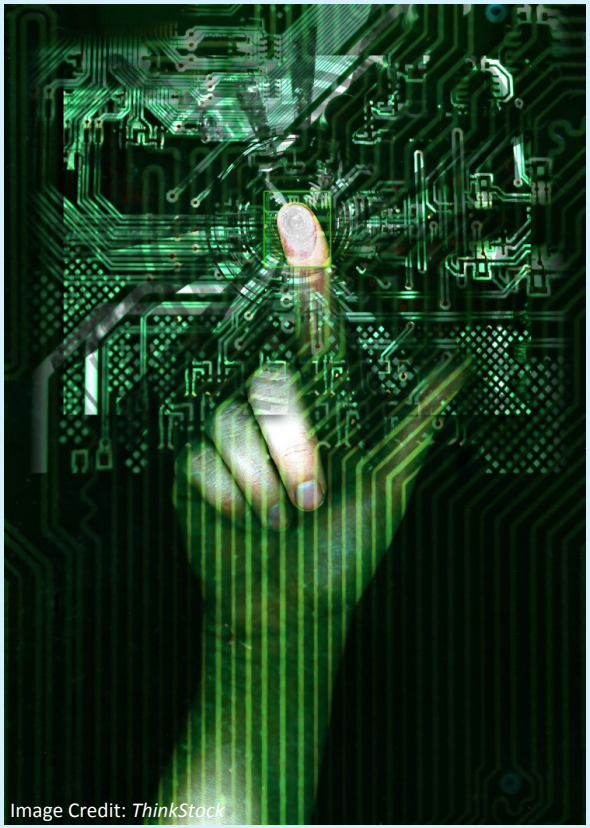


Image Credit: *ThinkStock*

- Aims to support fundamental scientific advances and technologies to protect cyber-systems from malicious behavior, while preserving privacy and promoting usability.
- Program addresses three perspectives:
  - Trustworthy Computing Systems
  - Social, Behavioral and Economic Sciences
  - Transition to Practice
- *Frontiers* support center-scale activities

Cross-Directorate Effort: CISE, ENG, EHR, MPS, OCI, and SBE

Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

- **600 Active Awards in cyber security**
- **$65M invested in SaTC Program in FY12**
- **90 new SaTC Awards**
- **35 small; 54 medium and 2 frontiers**
- **$45M in Scholarship for Service**

- Aims to support fundamental scientific advances and technologies to protect cyber-systems from malicious behavior, while preserving privacy and promoting usability.
- Program addresses three perspectives:
  - Trustworthy Computing Systems
  - Social, Behavioral and Economic Sciences
  - Transition to Practice
- *Frontiers* support center-scale activities

Cross-Directorate Effort: CISE, ENG, EHR, MPS, OCI, and SBE

Exploiting Parallelism and Scalability (XPS)

Supporting groundbreaking research that will lead to a new era of parallel computing

- Goal is to establish *new* collaborations combining expertise cutting across abstraction, software, hardware layers.
- Each proposal must have two or more PIs providing different and distinct expertise.

Foundational Principles

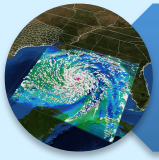
- New models guiding parallel algorithm design on diverse platforms
- Optimization for resources (energy, bandwidth, memory hierarchy)

Cross-layer Approaches

- Re-thinking/re-designing the hardware and software stack
- Coordination across all layers

Scalable Distributed Architectures

- Highly scalable and parallel architectures for people and things connected everywhere
- Runtime platforms and virtualization tools



Domain-specific Design

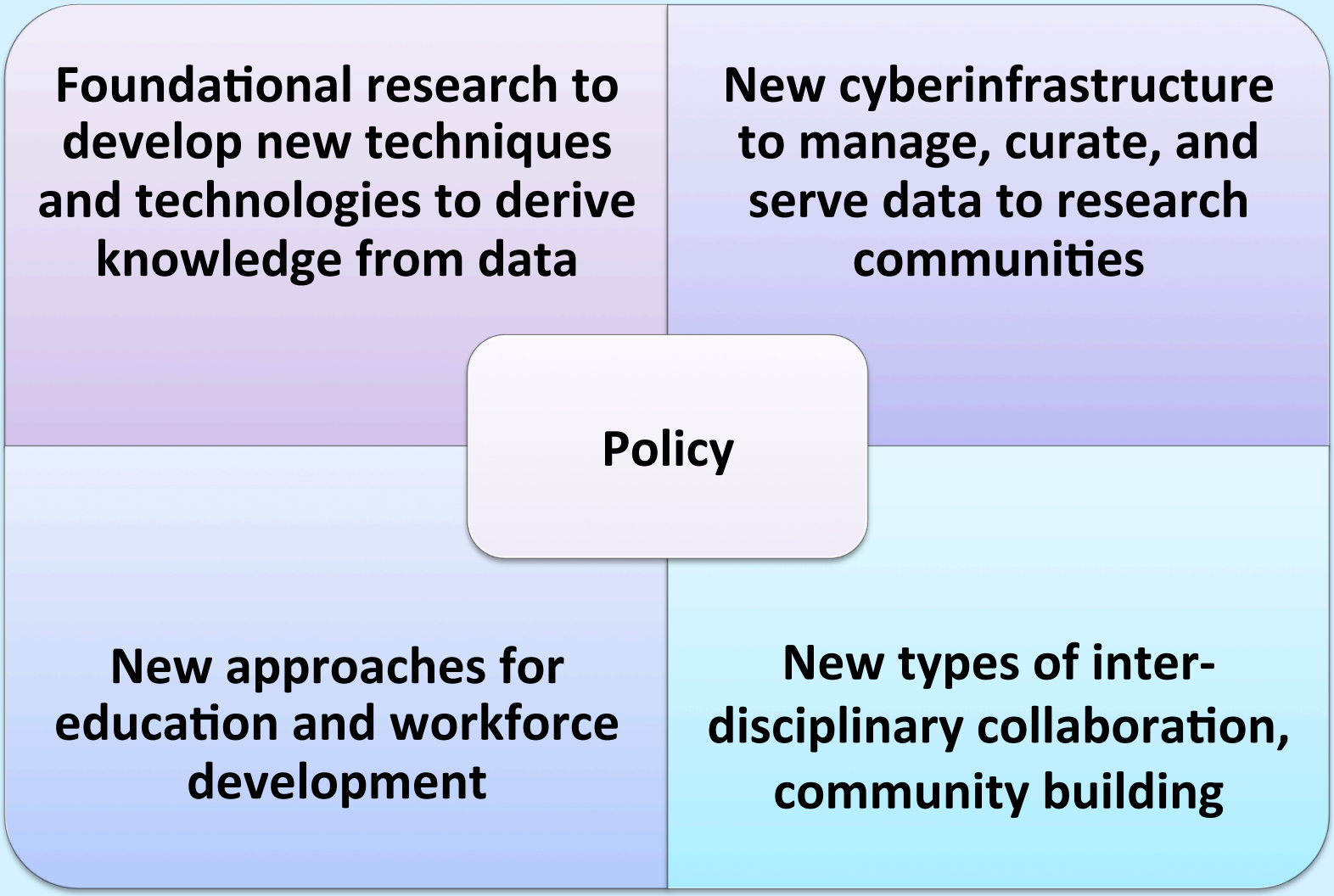
- Exploiting domain knowledge to improve programmability and performance

Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21)

Accelerating the progress of scientific discovery and innovation

- Cross-Directorate Partnership w/ BIO, CISE, ENG, GEO, MPS, SBE
- CISE focus in CIF21 includes:
  - **BigData** focuses on core scientific and technological means of managing, analyzing, visualizing and extracting useful information from large, diverse, distributed and heterogeneous data sets;
  - **DIBBS** aims to develop, implement, and support new cyberinfrastructure to store and manage the diversity, size and complexity of current and future data sets and data streams;
  - **SI²** advances new computational infrastructure, and catalyzes new paradigms and practices in the development and use of software that is robust, reliable, usable, and sustainable; and developing new computation and data research communities.

BIG DATA Initiative: Framework for Investments



Cyberinfrastructure Investments

- Advanced Computing
- Network Infrastructure, including International
- Data Systems and Management
- Mid-scale Research Infrastructure (*e.g.*, GENI)

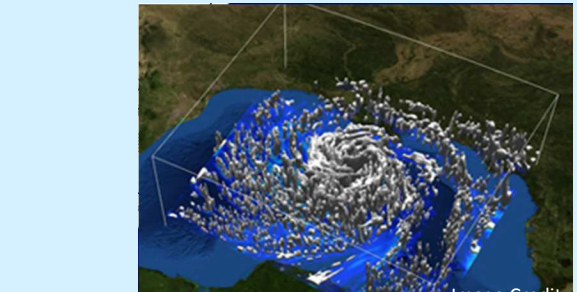


Image Credit: F. Zhang, PSU and Y. Weng

Image Credit: NCSA/ University of Illinois

Advanced Computational Infrastructure

- Anticipate and invest in diverse and innovative national scale shared resources, outreach and education complementing campus and other national investments

- Leverage and invest in collaborative flexible “fabrics” dynamically connecting scientific communities with computational resources and services at all scales (campus, regional, national, international)

Image Credit: *UC San Diego Publications/Erik Jepsen*

Image Credit: *University of Tennessee, Knoxville*

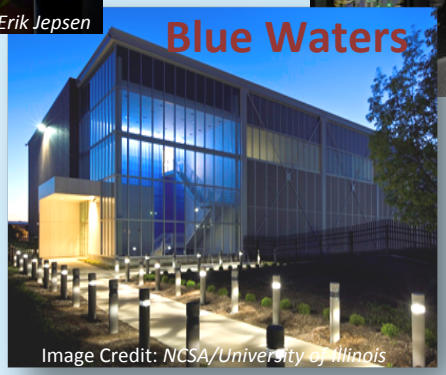


Image Credit: *NCSA/University of Illinois*

Image Credit: *TACC*

XSEDE
Extreme Science and Engineering Discovery Environment

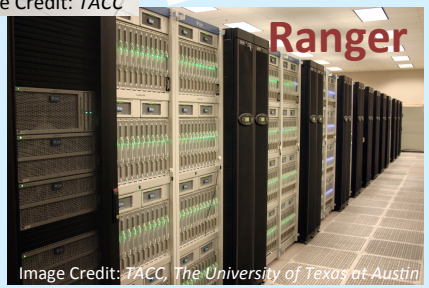


Image Credit: *TACC, The University of Texas at Austin*

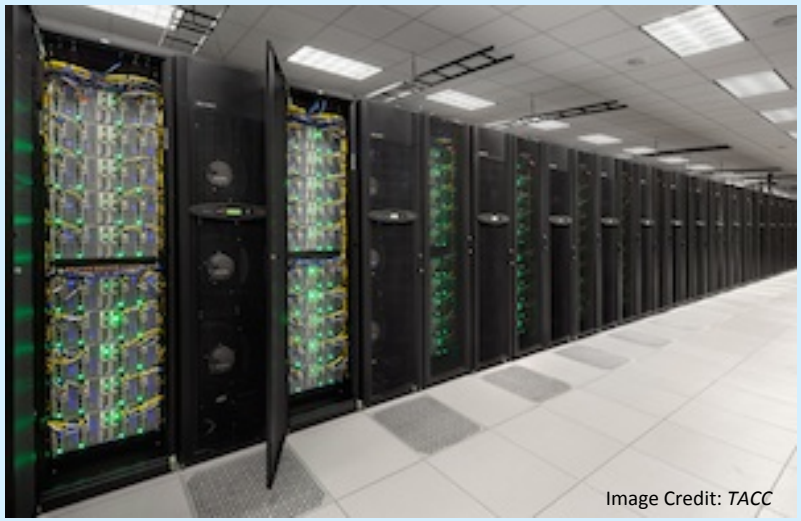
Major Advanced Computing Infrastructure Launched in FY 2013

Blue Waters, UIUC

National resource offering large allocations for a small number of diverse and significant research projects across the U.S.

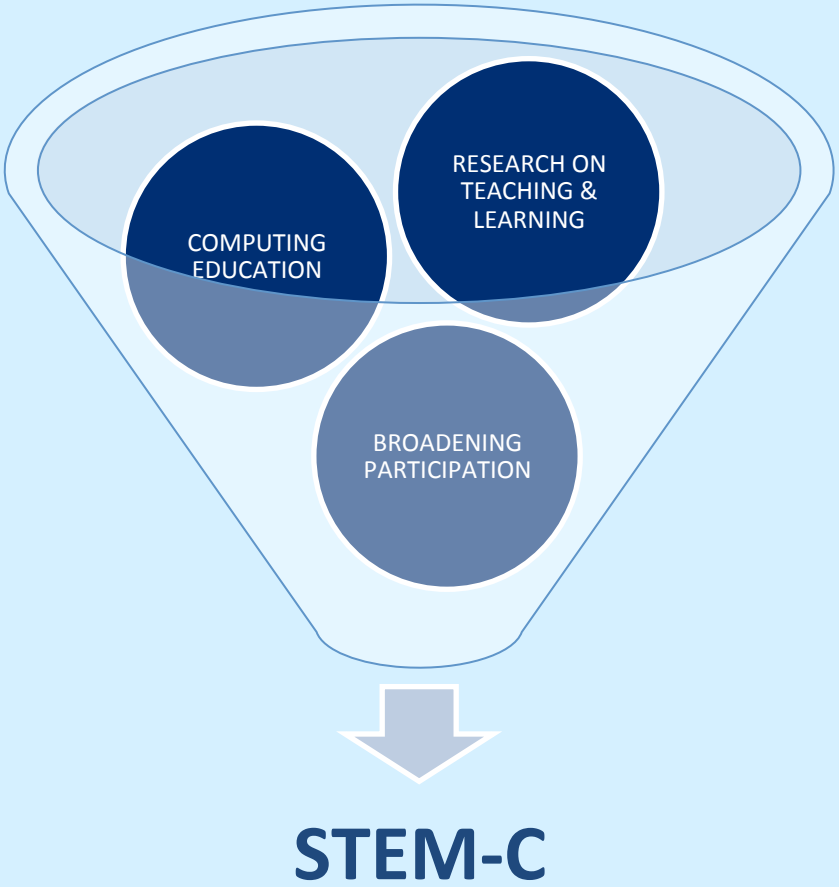
Stampede, UT at Austin

Empowers America's scientists and engineers to interactively share advanced computational resources, data and expertise to further research across scientific disciplines.



Science and Technology, Engineering, and Mathematics, including Computing (STEM-C) Partnerships

Enhancing computational competencies



- Joint activity between CISE and EHR
- Consolidation of the Computing Education for the 21st Century (CE21) program and Math and Science Partnerships (MSP) program
- CISE focus:
  - Increase number and diversity of K-14 students and teachers who develop and practice computational competencies.
  - Increase number of postsecondary students who have the background necessary to pursue degrees in computing and computationally-intensive fields.
- Transforming the computing education pipeline through CS10K

Cyberlearning

Improving learning by integrating emerging technologies with knowledge from research about how people learn

Computer science is both the **enabling discipline** for the development of technologies that enhance learning and a discipline with an **immediate and critical need** for cyberlearning technologies as it aims to scale K-16 educational transformations at the national scale

Goals:

- Understand how people learn in technology rich environments
- Design and study ways in which innovative technologies and tools can promote learning and support assessment
- Prototype new technologies and integrate them into learning environments

Cross-Cutting Investments

- Cyber-Enabled Sustainability Science and Engineering (CyberSEES)
- Enhancing Access to the Radio Spectrum (EARS)
- Smart and Connected Health
- Expeditions in Computing
- Innovation Corps (I-Corps)

Expeditions in Computing

- CISE's largest, long-term research investments → up to $10 million over five years
- Promotes *bold, ambitious, transformative* research that promises to help define the future of computing
- Drives far-reaching research motivated by deep scientific questions

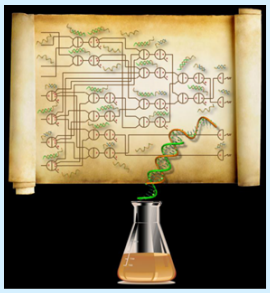


Image Credit: CalTech

Image Credit: Jason Dorfman, CSAIL/MIT

Image Credit: Harvard University


Image Credit: Harvard University

Expeditions in Computing

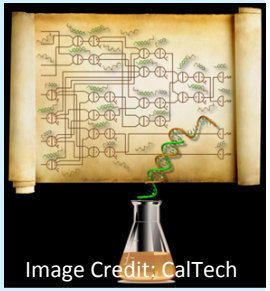


Image Credit: CalTech

Beyond Moore's Law

- *Variability-aware Software for Efficient Computing with Nanoscale Devices*, UCSD, UCLA, UIUC, Stanford, Michigan, 2010
- *Customizable Domain-Specific Computing*, UCLA, UCSB, Rice, Ohio State, 2009
- *The Molecular Programming Project*, CalTech, U Washington, 2008

Sustainability & Environment

- *Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010
- *Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society* – Cornell, Oregon State, Bowdoin, 2008

Wireless & Internet

- *Open Programmable Mobile Internet 2020,* Stanford, 2008

Healthcare & Wellbeing

- *Computational Behavioral Science: Modeling, Analysis, and Visualization of Social and Communicative Behavior,* Georgia Tech, MIT, Boston U, UIUC, USC, *Carnegie Mellon, 2010*
- *Socially Assistive Robots,* Yale, USC, MIT, Stanford, Willow Garage, 2011

Robotics

- *RoboBees: A Convergence of Body, Brain and Colony* – Harvard, Northeastern, 2009
- *An Expedition in Computing for Compiling Printable Programmable Machines,* MIT, U Penn, Harvard, 2011

Limits of Computation

- *Understanding, Coping with, and Benefiting from Intractability* – Princeton, Rutgers, NYU, Institute for Advanced Study, 2008

Formal Modeling and Verification

- *Next-Generation Model Checking and Abstract Interpretation with a Focus on Embedded Control and Systems Biology,* Carnegie Mellon, Stony Brook, NYU, UMD, Pitt, Lehman College, JPL, 2009
- *Expeditions in Computer Augmented Program Engineering,* U Penn, UC Berkeley, UMD, Rice, Cornell, U of Michigan, U of Illinois-UC, UCLA, MIT, 2011

Big Data

- *Algorithms, Machines, and People,* UC Berkeley, UC San Francisco, 2011
- *(Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010)

The full meeting agenda and locations may be found at: http://cadlab.cs.ucla.edu/beta/workshop/

Expeditions in Computing

PI Meeting Poster Session

Thursday, May 16, 2013, 10 AM - 12 PM

Stafford I Atrium

Expeditions in Computing inspires bold, transformative research that explores new scientific frontiers, promising disruptive innovations in computing.

This poster session will showcase the 14 Expeditions projects, each funded at up to $10 million over 5 years.

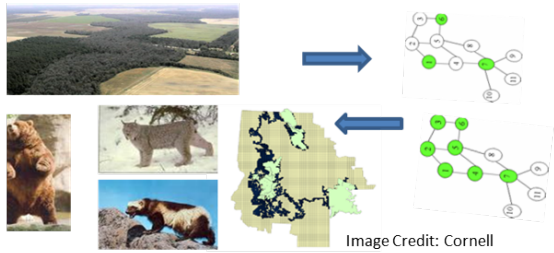


Image Credit: Cornell

Designing wildlife corridors for endangered species using ecological, biological, and economic data

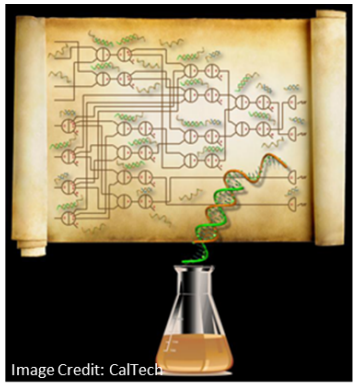


Image Credit: CalTech

Programming with biomolecules

Find out about exciting new research on robotics, Big Data analytics, sustainability, smart health and more!

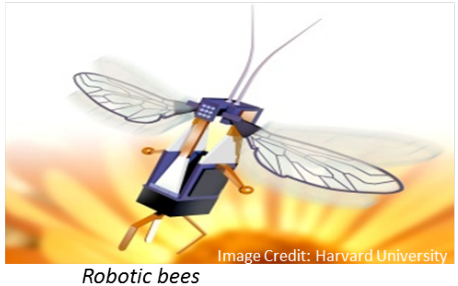


Image Credit: Harvard University

Robotic bees

Expeditions in Computing

14 awards made so far

(each award is for 5 years, $2M/year)

Year	Awards	Pre-projects	PI, Co-PI & SP	Institutions
2008	4	75	1000	166
2009	3	48	650	161
2010	3	23	232	76
2012	4	36	328	69

ISSUE: The Future of the Expeditions Program - Roundtable Discussion Topics at PI Meeting

1. **CISE portfolio balance – small, medium and large-scale awards**

2. **Project collaboration and coordination – incentives and best practices**

3. **Project self-assessment – what works and what doesn't**

4. **Program assessment – ideas for improvement in NSF oversight**

5. **Life after Expeditions – follow-on programs and funding mechanisms**

Innovation Corps (I-Corps)

Accelerating innovations from the laboratory to the market

- Aims to develop and nurture a national innovation ecosystem that builds upon fundamental research to guide the output of scientific discoveries to the development of technologies, products and processes that benefit society.
- Seeks to identify NSF-funded researchers to receive additional support - in the form of mentoring and funding.
- Two new subcomponents in FY 2013:
  - **Sites**: fund academic institutions with existing innovation units to enable them to nurture and support multiple, local teams to transition ideas, devices, processes or other intellectual activities into the marketplace.
  - **Nodes**: establish regional nodes to provide training to I-Corps teams; develop tools and resources that impact and expand benefits; identify and pursue longer-term research and development projects.

Award Information:

- 25 awards in FY11
- 100 awards in FY12

NSF-wide Initiative

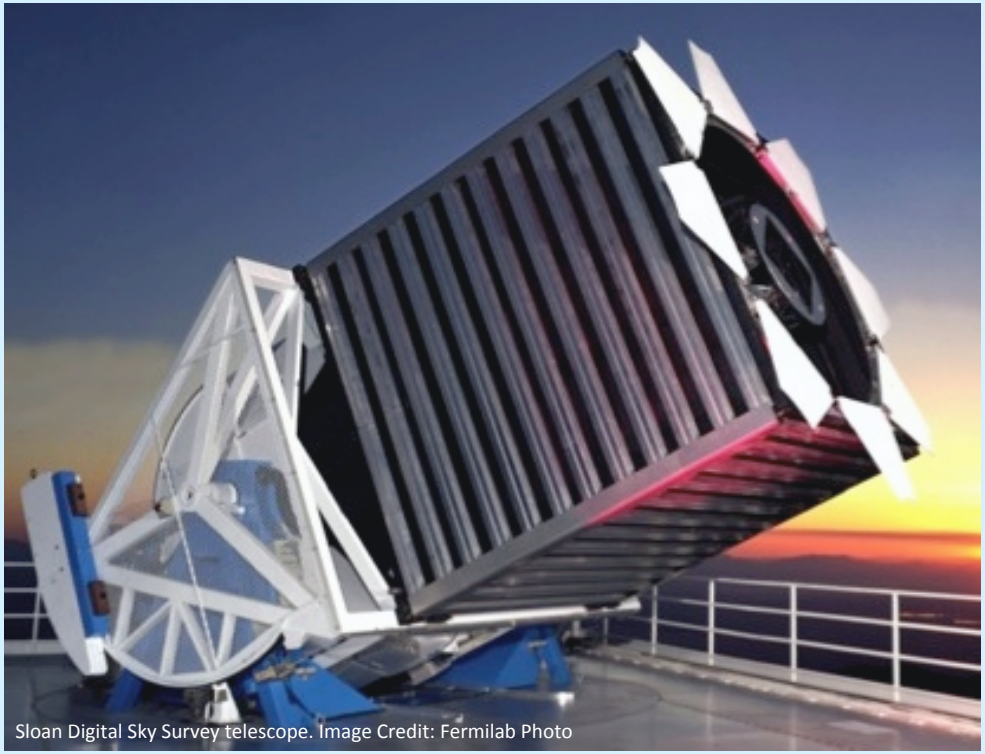
2013 Waterman Award

2013 Recipient: Professor Mung Chiang, CISE PI

From left to right: Vint Cerf, Cora Marrett, Mung Chiang, and Farnam Jahanian

- Most prestigious NSF award for young researchers
- $1M over 5 years

Looking Forward

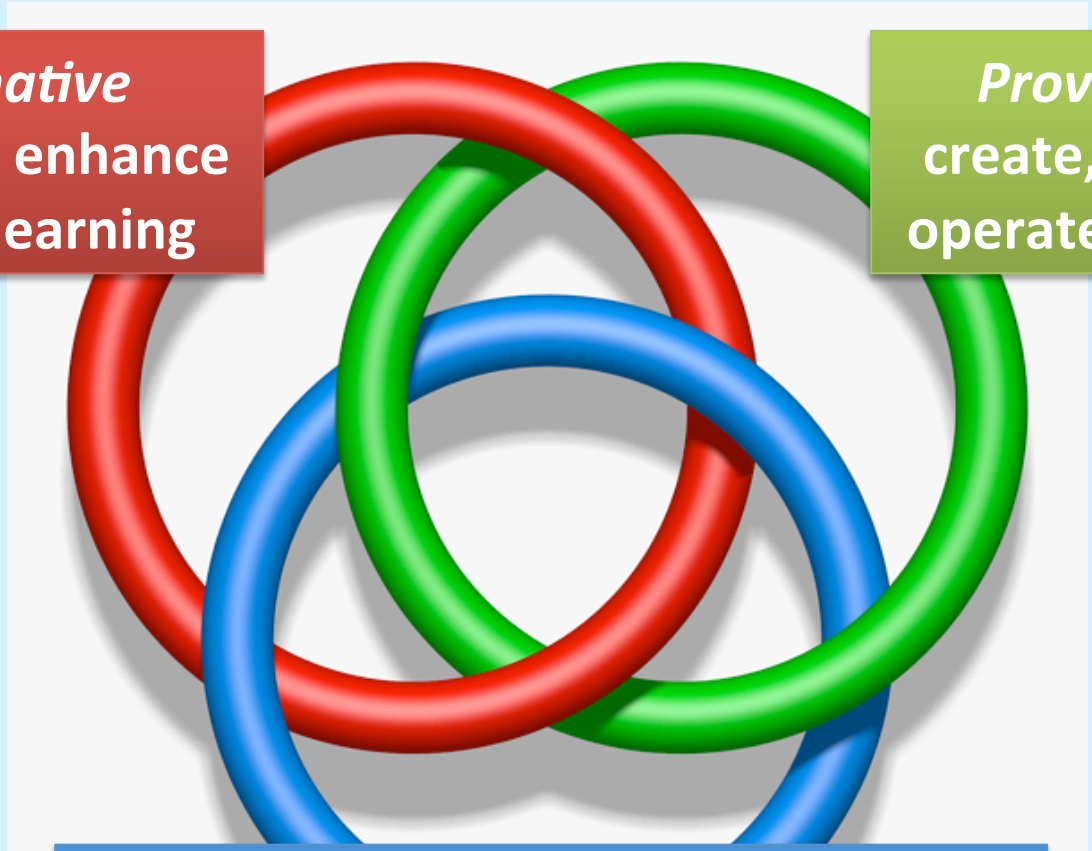


Sloan Digital Sky Survey telescope. Image Credit: Fermilab Photo

Advanced Cyberinfrastructure

Transformative Application **to enhance discovery & learning**

Provisioning **to create, deploy, and operate advanced CI**



R&D **to enhance technical and social effectiveness of future CI environments**

ACI Mission

The Advanced Cyberinfrastructure (ACI) Division supports and coordinates the development, acquisition, and provision of state-of-the-art cyberinfrastructure resources, tools and services essential to the advancement and transformation of science and engineering. ACI also supports forward-looking research and education to expand the future capabilities of cyberinfrastructure. By fostering a vibrant ecosystem of technologies and a skilled workforce of developers, researchers, staff and users, ACI serves the growing community of scientists and engineers, across all disciplines, whose work relies on the power of advanced computation, data-handling, and networking.

CISE Mission

- To enable the U.S. to uphold a position of world leadership in computing, communications, and information science and engineering
- To promote understanding of the principles and uses of advanced computing, communications and information systems in service to society
- To support and provide advanced cyberinfrastructure to enable and accelerate discovery and innovation across all disciplines
- To contribute to universal, transparent and affordable participation in an information-based society

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Thanks!

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